INTEGRATED FISHERIES MANAGEMENT OF LESS ECONOMICALLY VALUABLE SPECIES: A CASE STUDY OF ATLANTIC HAGFISH (MYXINE GLUTINOSA) IN NEWFOUNDLAND AND LABRADOR, CANADA

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Integrated Fisheries Management of Less Economically Valuable Species: A Case Study of Atlantic Hagfish (*Myxine glutinosa*) in Newfoundland and Labrador, Canada

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Abstract

To provide advice to fisheries managers, scientists study both commercially valuable species and species of ecological importance in order to learn their habits, biology, population dynamics, and ecological role. This data is then processed and interpreted and passed onto managers who use this information to establish yearly catch limits for commercial species. Historically, the large scale commercial fisheries in Newfoundland and Labrador have been based on species that have exhibited high abundance and low biomass. However, as the numbers of commercially valuable fish species continue to decline, harvesters are turning to species that are less abundant and of less commercial value in order to maximise the value of their annual income. In this context, less economic value would be a result of a low price per weight of species harvested, or a high price per weight, but low numbers of species actually harvested. In Canada, Fisheries and Oceans Canada (DFO) employs highly skilled and well educated scientists to study the biomass and abundance or formally abundant commercially valuable fishery species, but very few of these researchers are familiar with many of the less commercially valuable species. In order to be able to set responsible catch limits for these newly harvested species, the DFO must either hire more biologists who are familiar with these species, or develop methodologies which will provide them with the scientific data they require to ensure a sustainable harvest. This will require an integrated management approach, where harvesters will have a means to provide DFO with the data required for a sustainable management plan.

The objective of this paper is to demonstrate that traditional ecological knowledge of fish harvesters should continue to be integrated with conventional

fisheries research data in the importance of industry involvement during data collection. The resulting information could then be used to help determine if new and emerging fish species of less economic value can sustain a commercially viable fishery. The published paper; An Exploratory Fishing Survey and Biological Resource Assessment of Atlantic Hagfish (*Myxine glutinosa*) Occurring on the Southwest Slope of the Newfoundland Grand Bank (Grant, 2006) will be used as a case study to emphasize this point.

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CCFI	Canadian Centre for Fisheries and Innovation
DFA	Newfoundland and Labrador Provincial Government Department of Fisheries and Aquaculture
DFO	Fisheries and Oceans Canada
FMA	Fisheries Management Agreement
FMO	Fisheries Management Order
FMS	Fisheries Management Science
HADD	Harmful Alteration, Disruption or Destruction
ICNAF	International Convention for the Northwest Atlantic Fisheries
ITQ	Individual Transferable Quota
LOA	Length Over All
MWG	Monitoring Working Group
NAFO	Northwest Atlantic Fisheries Organization
OAG	Office of the Auditor General of Canada
SFHAC	Scotia-Fundy Herring Advisory Committee
STACFEN	Standing Committee on Fisheries Environment
STACFIS	Standing Committee on Fisheries Science
STACPUB	Standing Committee on Publications
STACREC	Standing Committee on Research Coordination
TAC	Total Allowable Catch
TEK	Traditional Ecological Knowledge

1.0 Introduction

Fisheries and Oceans Canada (DFO) has the lead federal role in managing Canada's fisheries and safeguarding its waters (DFO, 2012a). The Vision of DFO is "To advance sustainable aquatic ecosystems and support safe and secure Canadian waters while fostering economic prosperity across maritime sectors and fisheries (DFO, 2012a). While most Provinces and Territories of Canada have responsibility for any land- based fishery activity, it is DFO who is responsible for the management and conservation of Canada's ocean fisheries and ocean resources (Charles,1997). Historically, DFO has done this without consulting with the very people who have been directly impacted by these decisions. As a result, harvesters themselves have felt little incentive to conserve the resources, as was mandated by DFO.

In the early 1990's, shortly after the collapse and subsequent moratorium placed on groundfish fisheries in Atlantic Canada, DFO initiated a "Sentinel Fishery" in Newfoundland and Labrador to collect biological information on Northern cod (*Gadus morhua).* This data was collected by a select number of groundfish harvesters by using gillnets set in nearshore waters, and was given to the DFO for further analysis. While DFO had partnered with the fishing industry prior to this, by using both commercial catch data and data collected on DFO surveys to perform stock assessments, the Sentinel Fishery marked the first time that DFO actually partnered directly with the inshore fish harvesters. This is a step toward integrated fisheries management, where the Department of Fisheries and Oceans worked directly with both the fishing industry and the harvesters themselves. However, while data was collected by harvesters, the

passive gear that was utilized covered very little of the known distribution of cod within the Northwest Atlantic Fisheries Organization (NAFO) Divisions. The harvesters collected the data that was asked of them but they still only had limited input in management decisions.

Throughout Atlantic Canada, DFO implemented a Sentinel Fisheries program which used selected and trained fishers and their commercial gear to monitor fish stocks. Those harvesters selected were impressed with the data that was being collected and had an overall good feeling about combining the Sentinel Fishery data with other data typically collected. A bonus of the program was that, sentinel fishers became supporters of the science program and effective teachers of their colleagues. DFO scientists have also invited fishers to participate in phases of their scientific work including sailing on research vessel cruises and participating in stock status discussions. Reactions to these interactions vary, but were generally thought favorable by both fishers and scientists.

The sentinel surveys were introduced on cod stocks under moratorium and originated from the general concern that, in the absence of a commercial fishery, information on these stocks would be based solely on research surveys and commercial catch data. Sentinel surveys provided DFO with additional abundance indices, as well as information on fish distribution, fish growth, fish condition and a detailed profile of sizes and ages in the stocks in waters close to shore. This data could then be compared to research data and commercial data from both the inshore and offshore areas.

The 1992 closure of the Northern cod fishery is still in effect today in Newfoundland and Labrador, with the exceptions of a few relatively small commercial inshore cod fisheries in NAFO fishing areas 2J and 3KL. However, many former groundfish harvesters upon realizing the market demand and value of snow crab (*Chionoecetes opilio*) and northern shrimp (*Pandalus borealis*) either modified their existing vessels or purchased new ones, primarily to harvest these two types of shellfish. Both of these species have proven to be financially lucrative. However, as shown in Table 1, in 2009 both landings and landed value for shrimp and crab decreased substantially.

Table 1

Landings and landed value of cod, crab, and shrimp from 2005 to 2012

	Landings (tonnes)		Landed Value ($000's)	
	Cod	Crab & Shrimp	Cod	Crab & Shrimp
Year				
2005	16,257	145,109	17,215	298,448
2006	17,050	153,694	19,706	235,646
2007	17,845	165,430	25,613	338,893
2008	17,599	163,844	28,278	358,207
2009	14,472	131,123	14,967	273,963
2010	12,028	147,296	12,263	294,576
2011	9,746	139,764	11,228	439,898
2012	8,139	136,097	9,390	408,728

Note: values are rounded
: 2012 values are preliminary
Source: DFA (2005-2012)

Many harvesters, fearing that the shellfish would suffer the same fate as the cod fish, turned to harvesting locally unexploited species of less economic value in order to

maintain or possibly increase their financial standing. In this context, less economic value would be a result of a low price per weight of species harvested, or a high price per weight, but low biomass of species actually harvested. There has always been interest in developing fisheries for emerging species (eg. lumpfish (*Cyclopterus lumpus)* in 1969) but the need to diversify became necessary with the collapse of groundfish fisheries. In Newfoundland and Labrador, two species in particular, hagfish (*Myxine glutinosa*) and sea cucumbers (*Cucumaria frondosa*), have recently been targeted.

While the Newfoundland and Labrador region of the DFO employs highly educated and highly respected biologists and researchers, they are primarily responsible for providing scientific advice on large scale commercially valuable fisheries species with a long history of being prosecuted in the region. With harvesters quickly learning where and when the less valuable species can be harvested, DFO is faced with the challenge of trying to assess the various stocks of these species and assigning catch quotas, without having necessary scientific knowledge of the biology, distribution and biomass of these species. To obtain this knowledge, it is essential that DFO partner with harvesters and academic institutions that employ scientists who have the ability to design and perform the research necessary to obtain this important information.

In 2002, researchers from the Centre for Sustainable Aquatic Resources, of the Marine Institute of Memorial University, with the aid of the commercial fishing industry, initiated a long term study on Atlantic hagfish (*Myxine glutinosa*), to determine whether the resource could sustain a commercially viable fishery, and to collect scientific information on which to build databases for stock assessment purposes (Grant, 2006). Funding, both monetary and in kind contributions, for this study was provided from

several sources, including the Canadian Centre for Fisheries Innovation (CCFI), the Newfoundland and Labrador Provincial Government Department of Fisheries and Aquaculture (DFA), the Fisheries and Marine Institute and DFO. The choice of survey and exploratory fishing area was based on traditional ecological knowledge of gillnet fishermen (Grant, 2006). This is a good example of integrated fisheries management, exhibiting the cooperation between DFO science and management, industry and the Marine Institute. The Marine Institute is an independent education and research institution working with fish harvesters to integrate their traditional knowledge into a scientific data base that can be used by the DFO to help determine sustainable harvest limits.

A review of fisheries management practices in the Northwest Atlantic region and the Atlantic region specifically, show that while many positive results have been achieved over time, very little consultation with the resource harvesters has taken place.

2.0 A Review of Fisheries Management in the Northwest Atlantic

Until the discovery of Newfoundland and its rich abundance of fishery resources, there was no commercial fishing in the western North Atlantic. When John Cabot arrived on the shores of Newfoundland over 500 years ago, cod was so plentiful that sailors could reportedly scoop them up into their ships with buckets, "and they affirm that the sea is covered with fish which are caught not merely with nets but with baskets, a stone being attached to make the baskets sink in the water..."(Judah, 1933). For Cabot and other early explorers and settlers, Newfoundland's cod was a valuable resource that fostered a lucrative fish trade between North America and Europe.

Both the Portuguese and French began fishing in Newfoundland waters in the early 1500's, and even though Newfoundland was a British colony then, the British did not start fishing in the area until approximately 1560 (Pope, 1992). The population of Newfoundland began to grow as the numbers of migratory fishermen from Spain, Portugal, France and England increased. These fish harvesters would sail from their homelands in the spring and returned in autumn with cargoes of salted cod. While there were many species of fish in Newfoundland waters, only the plentiful cod fish were harvested (Lear, 1998). Eventually, many of these migrants stayed and over wintered in Newfoundland, resulting in a growing permanent population; a trend which continued into the late 1800's to early 1900's.

Up to this point, the fishery was unregulated. It was an open access system, where all inshore fish harvesters could catch whatever they were capable of. Of course, the numbers of cod were quite high, while the numbers of fishermen were fairly low, and the technology being used to capture the fish was relatively simplistic. The first Canadian Commissioner of Fisheries, Dr. E.E. Prince, was not appointed until1893, and there were no regulations on groundfish species in Canadian waters until the 1940's. There was, however, a limit placed on the number of trawlers in the 1920's and 1930's in response to pressure from hook-and-line fishermen, but it was relaxed towards the end of World War II (Anderson, 1998).

Several European countries had targeted the Grand Banks in the Northwest Atlantic as their primary fishing location, dating back several hundred years. Fishing intensified after the end of World War II, and by the late 1940's to early 1950's, increasing numbers of trawlers began appearing in the waters off Newfoundland and

Labrador and West Greenland. As a result of a decline in the abundance of fish stocks and concern over this starting to increase, the USA convened a conference to review the situation. In January of 1949, in Washington, D.C., a meeting that involved 10 countries resulted in the establishment of the International Convention for the Northwest Atlantic Fisheries (ICNAF). While this is certainly a significant event in Canadian fisheries management, it is also significant to note that the representatives from each of the 10 nations were only concerned with the abundance of cod that could be taken in the offshore fishery. The smaller inshore cod fishery was given very little, if any attention (Anderson, 1998).

2.1 International Convention for the Northwest Atlantic Fisheries (ICNAF)

The ICNAF was designed to provide for the investigation, protection and conservation of the fisheries of the Northwest Atlantic in order to make possible the maintenance of a maximum sustained catch from those fisheries (ICNAF, 1951). Standing committees on Finance and Administration and Research and Statistics were established at the first meeting, with the latter to recommend the coordination of research programs in the various countries and advise the Commission on improvements deemed desirable in the collection of statistics and research programs.

Article IV of the Convention stipulated the establishment of a Panel for each of the fisheries sub-areas of the Northwest Atlantic to be responsible for keeping under review the fisheries of its sub-area and the associated scientific and other information. Also, each of these panels, on the basis of scientific investigations, would make recommendations to the Commission for adoption. These recommendations would

cover such issues as regulatory measures and scientific studies and investigations to be undertaken by the Contracting Parties. Panel membership by Contracting Parties was contingent upon having current substantial exploitation in the sub-area in question or having a coastline adjacent to the sub-area. Article VIII of the Convention authorized the Commission to adopt regulatory measures including: a) establishing open and closed seasons, b) closing particular areas because of spawning or small/immature fish, c) establishing size limits of fish, d) prohibiting particular fishing gear, and e) specifying an over-all catch limit for any species.

The ICNAF collection and reporting system for catch statistics and biological data led to the establishment of one of the world's best fisheries data bases (Anderson, 1998). Most ICNAF member countries were using fishery research vessels by the early 1950's, but fishery catch and effort data were the basis for most if not all stock assessments until the early 1970's, when research vessel surveys were implemented in nearly all of the ICNAF sub-areas. Also, survey data began to be used more and more frequently, particularly for stocks in US waters where standardised bottom trawl surveys, based on stratified random sampling design, had begun in 1963 (Anderson,1998).

The number of Contracting Parties increased from the initial five in 1951, to 18 by 1975, and decreased again to 12 by the time that ICNAF officially dissolved on December 31, 1979. Throughout this time, only data acquired from offshore commercial records and fishery research vessels were utilized for fisheries statistical analysis. Furthermore, only large scale commercial fisheries were being studied, and the concept of new emerging fisheries had not been considered.

2.2 Northwest Atlantic Fisheries Organization (NAFO)

In 1976, when both the USA and Canada declared their intentions to extend their fishing zones to 200 nautical miles, the ICNAF Contracting Parties decided to create a new arrangement for multinational fisheries management in the Northwest Atlantic.

The Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries resulted from several conferences held in Ottawa in1977 and 1978 and came into effect on January 1, 1979. This Convention provided for the establishment of the Northwest Atlantic Fisheries Organization (NAFO). Following a one year transition between the two organizations, ICNAF was officially dissolved effective December 31, 1979 (NAFO, nd).

The objective of NAFO, as stated in Article II of the Convention, is "to contribute through consultation and cooperation to the optimum utilization, rational management and conservation of the fishery resources of the Convention Area." The Convention applies to all fishery resources in the Convention Area except salmon, tunas and marlins, cetaceans managed by the International Whaling Commission, and sedentary species (e.g. shellfish) (NAFO, n.d.).

NAFO is organized into three principal bodies: the General Council, the Fisheries Commission, and the Scientific Council. Although NAFO retained the same Convention Area as ICNAF, the NAFO Regulatory Area is only that part of the Convention Area which lies beyond the areas in which Coastal States exercise fisheries jurisdiction (i.e. beyond the 200 nautical mile Exclusive Economic Zone).The General Council is responsible for overseeing all organizational, administrative, financial and

internal and external affairs of NAFO. The Fisheries Commission is responsible for the management and conservation of the fishery resources in the Regulatory Area. The functions of the Scientific Council are as follows (NAFO, n.d.):

a) To provide a forum for consultation and cooperation among Contracting Parties with respect to the study, appraisal and exchange of scientific information and views relating to fisheries of the Convention Area, including environmental and ecological factors affecting these fisheries, and to encourage and promote cooperation among the Contracting Parties in scientific research designed to fill gaps in knowledge pertaining to these matters;
b) To compile and maintain statistics and records and publish or disseminate reports, information and materials pertaining to the fisheries of the Convention Area, including environmental and ecological factors affecting these fisheries;
c) To provide scientific advice to Coastal States, where requested to do so pursuant to Article VII; and
d) To provide scientific advice to the Fisheries Commission, pursuant to Article VII or on its own initiative as required for the purpose of the Commission.

Each Contracting Party is a member of the Scientific Council, which has three standing committees: 1) Standing Committee on Fisheries Science (STACFIS), 2) Standing Committee on Research Coordination (STACREC), and 3) Standing Committee on Publications (STACPUB). In 1994, a new Standing Committee on Fisheries Environment (STACFEN) was established to replace the STACFIS Environmental Subcommittee (NAFO, n.d.).

The NAFO Scientific Council made significant contributions to fisheries management. It has provided assessments, to the extent that reliable input data have been available, and has been forceful in recommending closure of fisheries when stock abundance has been deemed unacceptably low. It has also contributed to fisheries science through its cooperation with other organizations and its sponsorship of annual scientific fora for the review of relevant topics.

3.0 A Review of Fisheries Management in Atlantic Canada

Atlantic Canada has always enjoyed a very strong and successful history in fish harvesting. The total catch of all species in 2009 was 755,408 metric tonnes, with an associated value of $1.42 billion. Atlantic fisheries dominate Canada's commercial harvest, with approximately 80 – 85% of total harvest and total value (DFO, 2012b).

In the Atlantic Canadian fishery, commercial fishers tend to be identified mainly by the fish species they harvest and the size of their vessels. In order to allow for the independence of fish harvesters from the processers, DFO initiated the Owner Operator/Fleet Separation Policies. The intent of these policies is to protect the independence of the inshore fleet from control by other interests such as processing companies (DFO, 2003). Under the owner-operator provision, inshore refers to the fishing vessel sector where fish harvesters are restricted to using vessels less that 19.8m (65') Length Over All (LOA), and in the Newfoundland and Labrador Region, where fish harvesters may be permitted to use a vessel less than 27.4m (90') LOA where specific conditions are met (DFO, 2010). The fleet separation policy, initially adopted in 1979, covers fisheries where licence holders are restricted to using vessels

less than 19.8 meters in length. The policy specifies that corporations (i.e. processing industries) may not hold new fishing licences for vessels less than 19.8 meters in length (DFO, 2003).

The stocks that can be fished depend on what licences are held and the home region of the fisher. Some harvesters, especially those targeting shellfish, tend to use very similar gear within a given fishing area. Harvesters in the groundfishery, however, use a variety of gear types and vessel sizes, which ultimately lead to both conflicts and complicated management issues.

Fishers live in over 1000 coastal fishing communities throughout Atlantic Canada. There are a variety of gear based and community based organizations, however not all fishers chose to join these organizations, and prefer to remain independent. This is in contrast to the processing sector, which is relatively well organised, and is closely involved in policy debates. Coastal communities have relied heavily in the past, and to a lesser extent now, on local processing plants for employment, and inshore fishers rely on processors to buy their catches. The entire offshore component of the groundfish fishery is dominated by vertically integrated companies, including processors, as per the DFO's "Fleet Separation Policy" (DFO, 1996).

While the provincial governments have responsibility for managing any land-based fishery activity, including fish processing and aquaculture, the Federal government has the responsibility for management of Canada's ocean fisheries and in particular for conservation of ocean resources (Charles,1997).

3.1 The Downturn and Collapse of the Atlantic Canada Groundfishery

When discussing the groundfishery in Atlantic Canada, attention must be brought to the two major events in the fishery: the downturn of the fishery in the 1970's, followed by the collapse in the 1980's and '90's. The downturn occurred in the early and mid 1970's, driven largely by heavy fishing pressure by foreign vessels that continued up to 1977. With more conservative management and some strong year classes recruiting to the fishery, groundfish stocks rebounded in the late 1970's and early 1980's.

The collapse, in the late 1980's and early 1990's, arose from very high levels of domestic and in some cases, foreign fishing mortality, compounded by the onset of less favourable environmental conditions (Charles, 1979). In 1992, the federal government closed the "Northern cod" fishery in NAFO area 2J3KL, a fishery that had been one of the worlds largest and of enormous importance to Newfoundland and Labrador.

Whereas many inshore fishers had been expressing alarm for years about the decline that they perceived in this stock, it was a failure of the "offshore" trawler fishery to find fish that led the government to end harvesting (Charles, 1997). Relations between inshore fishers and the DFO were always somewhat strained. As mentioned earlier in the discussions of ICNAF and NAFO, the data obtained for calculating stock assessments was obtained from offshore research trips and from offshore commercial catch data. Inshore fishers were not asked, nor given the avenue to express their concerns regarding fisheries management issues, and this led to an even greater distrust between them and the DFO. The effect of the moratorium on Northern cod was

felt very strongly in Newfoundland and Labrador as a large group of people suddenly found themselves in a position where they had no employment and little or no income. It did, however, force some harvesters to consider fishing for alternate species and less economically valuable species. The original two year moratorium of 1992 has been extended indefinitely as the stock has still not fully recovered.

Current practices being utilized to manage Atlantic Canada's groundfishery include a combination of measures, including key elements of quota management (to limit harvests), limited entry licensing (to limit participation), gear restrictions (to enhance the selectivity of fishing) and closed areas and closed seasons (to protect spawning and/or nursery grounds) (Charles, 1997).

With the collapse of Atlantic Canada's groundfishery in the early 1990's, criticism grew over the state of the scientific management system. One of the reasons for this failure may well have been the over-reliance on quota management and its process of setting and subdividing the Total Allowable Catch (TAC). Add to this an adversarial relationship between government and fishers, and an environment was created in which fishers operated illegally, by dumping and discarding fish, a process known as "high-grading", and grossly misreporting catches. High-grading is a practice of selecting the most desirable fish to bring ashore for market. Usually, higher prices are paid for larger fish, so as more fish are caught, smaller less desirable fish are discarded and more desirable, larger fish are kept. This is often associated with fishing quotas, where only a limited amount or size of fish, are allowed to be harvested.

Quota management has been the main method of groundfish regulation in Atlantic Canada. The process involves estimating the biomass for each stock through complex modelling, and determining an allowable harvest quota, or TAC. The TAC is then subdivided by the various sectors (gear, boat size, etc). Quota setting requires knowledge of fish biomass. However, the two primary sources of the assessment information, research vessel surveys and commercial catch data, have proven not to be reliable. Research vessels cannot fully capture the spatial distribution of stocks, since they fish in randomly selected areas, and almost exclusively only in offshore areas. Commercial catch data is often not completely accurate, since it only indicates the catch, but not the amount of effort that it took to harvest that amount of catch. The fact is that even as stocks declined, fishers were able to find and catch the remaining fish, leading to the false assumption that high catch rates reflected a healthy stock. The anti-conservationist behaviour of high-grading and the misreporting of catch data resulted in faulty assessments of stock status and over estimates of feasible catch levels.

Canada has traditionally taken a "top down" approach to fisheries management, where federal agencies have collected and analysed data, and utilized the results to set policies and regulations that fishers were to follow. The fishers themselves, however, did not have any input into this process. This may have been due to a lack of understanding of the complexities of science and management information and the decision making framework, as well as the perception that some DFO representatives may have: harvesters are selfish profit maximisers who knew how to work the system to their advantage and were not seen as regulators who were acting to protect the resource. While there have been, and continue to be, many complex factors influencing

harvester behaviour, it could be argued that justifiably or not, the harvesters have been perceived by some DFO representatives in this manner. While it was certainly unfair to include all harvesters with that characterisation, unfortunately, that perception manifested itself when fishers in Atlantic Canada were excluded from management decision making, and their incentive to conserve the resource was diminished.

In an attempt to move from this "we – they" dynamic, DFO moved toward a consultative model, in which the government discussed management measures with the harvesting industry prior to implementation. However, consultations did not equate to decision making power, and as a result, most fishers did not buy into the government imposed regulations. Also, there was a perception among inshore fishers that the consultative mechanism favoured the larger scale players in the groundfishery, and was of no advantage to them.

4.0 Towards Integrated Management: Proposed Amendments to the Fisheries Act

The Minister of Fisheries and Oceans exercises his or her responsibility for Canadian fisheries through the activities of the DFO. Although the DFO has existed in some form since 1868, the Department of Fisheries and Oceans Act was first enacted in 1978. This legislation sets out the powers, duties and functions of the Minister and empowers the Minister to enter into agreements with any province (or provincial agency) regarding fisheries programs (Cohen Commission, 2010).

The DFO's mandate and objectives originate in various federal statutes and accompanying regulations. The pertinent statute to be examined here is the Fisheries Act. The Fisheries Act was established to manage and protect Canada's fisheries

resources. It applies to all fishing zones, territorial seas and inland waters of Canada and is binding to federal, provincial and territorial governments (DFO, 2013). For the purpose on enhancing clarity, it should be noted that the Department of Fisheries and Oceans Act, and the Fisheries Act are two separate pieces of legislation.

Section 43 of the Fisheries Act affords the Governor-in-Council broad authority to make regulations for carrying out the purposes and provisions of the Fisheries Act, which includes: the conservation and management of fish; the conservation and protection of spawning grounds; the use of fishing gear and equipment; the operation of fishing vessels; and issues relating to licensing.

Since 1995, there have been at least two attempts to "modernize" the Fisheries Act with respect to fisheries management. While the specific provisions of each proposed Act differed, they both shared a number of important principles and goals, including: the introduction of a preamble promoting a precautionary approach to conservation; the strengthening and clarification of the habitat-protection provisions of the existing Act; the establishment of a new mechanism for handling violations and appeals; and the delegation of management responsibility to the fisheries users themselves (Cohen Commission, 2010). This last provision is extremely important as it marks the time when DFO officially recognized that the fishers themselves should be able to take part in the fisheries management decision making process.

4.1 Bill C-62

The first attempt at modernization, Bill C-62, an Act respecting fisheries was tabled on October 3, 1996 by the Liberal government under Prime Minister Jean

Chrétien. Prompted in part by significant cuts to DFO's budget, Bill C-62 proposed to transfer a large portion of the responsibility and costs of fisheries management to the resource users, thereby creating a less costly but more transparent and inclusive management regime (Cohen Commission, 2010). While the reason behind why this Bill was introduced may not be the most noble, the impact on fishers could have been quite significant. It would finally allow harvesters to have input into fishery management decisions, essentially deeming them masters of their own destiny. It was presumed that harvesters would not break the rules which they themselves instituted, since they would have no one to blame but themselves if there were negative consequences.

The preamble to Bill C-62 incorporated principles of sustainable development and promoted the broad application of the precautionary principle to the conservation, management and exploitation of marine resources in order to protect the marine resources and to preserve the marine environment. The proposed preamble also stated that Parliament intended the powers, duties and function of the Minister to be exercised to conserve Canada's fisheries in the interest of present and future generations of Canadians (Cohen Commission, 2010).

Sections 10 to 13 of Bill C-62 would have enabled the Minister to issue "fisheries management orders" (FMOs). The use of FMOs was intended to streamline the management of fisheries by reducing the DFO's reliance on the regulatory process. Under proposed section 13, the power to make FMOs could have been delegated to the provinces (Cohen Commission, 2010).

Bill C-62, in sections 17 to 21, would have also enabled the Minister to enter into "fisheries management agreements" (FMAs), or long-term partnership agreements with

"representative organizations" to manage fisheries. A FMA could have covered harvest limits; conservation and management measures and programs; numbers of licences; licence and lease fees; and obligations, responsibilities and funding arrangements with respect to management of the fishery. A FMA would have prevailed in the event of a conflict between the FMA and a provision of the regulations, but the FMA would not have limited the Minister's power to issue a FMO (Cohen Commission, 2010).

Unfortunately, Bill C-62 died on the Order Paper with the call of the 1997 general election.

4.2 Bill C-45

The second attempt to modernize the Fisheries Act was Bill C-45, an Act respecting the sustainable development of Canada's seacoast and inland fisheries, tabled on December 13, 2006 by the Conservative government under Prime Minister Stephen Harper. Bill C-45 was the culmination of the Fisheries Renewal Initiative, a program introduced in the DFO's 2005-2010 Strategic Plan; Our Waters, Our Future. Bill C-45 aimed to reaffirm and strengthen the goal of conservation and protection of fish and fish habitat, and to improve stability, transparency and predictability in fishery access and allocation (Cohen Commission, 2010).

Section 6 set out a list of "application principles" with which all persons engaged in the administration of the proposed Act or its regulations would have had to comply.

Such persons would have been obliged to:

a) take into account the principles of sustainable development and seek to apply an ecosystem approach;

b) seek to apply a precautionary approach such that, if there is both high scientific uncertainty and a risk of serious harm, they will not use a lack of adequate scientific information as a reason for failing to take, or for postponing, cost-effective measures for the conservation or protection of fish or fish habitat that they consider proportional to the potential severity of the risk;

c) take into account scientific information;

d) seek to manage in a manner consistent with the constitutional protection afforded to existing aboriginal and treaty rights of Canada's aboriginal peoples;

e) consider traditional knowledge, to the extent that it has been shared with them;

f) endeavour to act in cooperation with other governments and with bodies established under land claims agreements; and

g) encourage the participation of Canadians in the making of decisions that affect the management of fisheries and the conservation or protection of fish or fish habitat (Cohen Commission, 2010).

From the harvesters' perspective, the two most relevant principles here are e) and g). While there was an uncertainty as to how DFO could incorporate traditional knowledge into their scientific database, at least this exhibited a willingness to listen. It is quite vague as to what "consider traditional knowledge" actually means, but it at least recognizes that the knowledge that has been handed down to harvesters, from generation to generation, may be able to supplement the scientific database. Point g) does not necessarily specify fish harvesters in particular, but it does allow them the opportunity to participate in the decision making process.

Like Bill C-62 before it, Bill C-45 would have transferred, again through FMAs, some control and responsibility for fisheries management to the resource users themselves. In addition, Bill C-45 would have created a Canada Fisheries Tribunal to deal with certain fisheries violations and licensing appeals, and it would have retained, for the most part, the general prohibition on the harmful alteration, disruption or destruction (HADD) of fish habitat (adding a clarification that an "alteration" or "disruption" must be harmful for the prohibition to apply) (Cohen Commission, 2010).

Unfortunately, like Bill C-62 before it, Bill C-45 also died on the Order Paper, when the 1st session of the 39th Parliament was prorogued on June 22, 2007. However, the very fact these two amendments to the Fisheries Act were even brought forward, indicated that the government recognized the fact that the users of the resources should be able to contribute input into the management of those resources, and that some form of fisheries co-management is required.

5.0 Fisheries Co-management

Stephenson and Lane (1995) presented a critique of the current state of fisheries science and fisheries management, and proposed a direction for major change. Foremost among the problems diagnosed was the need for more integrated approaches to fisheries management decision making. It was argued that strict disciplinary approaches in the domains of fisheries science or biology, operations management and socio- economic considerations have led to separate management processes for these functions and there was a lack of an appropriate holistic context for the management of commercial fisheries. A framework was prescribed for developing strategic

management alternatives and for evaluating these relative to scientific, economic, sociological and political considerations using the structured techniques of decision analysis from the field of management science. "Fisheries Management Science" (FMS) was coined to denote the interdisciplinary roles of fisheries management, fisheries science, and management science in dealing with fisheries issues. In making this proposal, the need for meaningful involvement of interested parties in management – or more appropriately, the need for fisheries co-management was recognized (Lane and Stephenson, 1998).

The effectiveness of existing fisheries management regimes in maintaining or achieving sustainable resource utilisation is constantly debated and questioned as fisheries in many parts of the world, including Atlantic Canada, continue to be under pressure or in crisis. Recently, as Bill C-45 and Bill C-62 has shown, there has been growing recognition that user groups have to become more actively involved in fisheries management if the regime is to be both effective and legitimate. While there is no set definition for co-management, most are quite similar, generally viewing it as an arrangement where responsibility for resource management is shared between the government and user groups (Sen & Nielsen, 1996). It is considered to be one solution to the growing problems of resource over-exploitation.

Sen and Nielsen (1996), classified co-management arrangements into five broad types according to the role government and users play:

Type A: Instructive: There is only minimum exchange of information between government and users. This type of co-management regime is only different from

centralised management in the sense that the mechanism exists for dialogue with users, but the process itself tends to be government informing users on the decisions they plan to make.

Type B: Consultative: Mechanism exists for government to consult with users but all decisions are taken by government.

Type C: Cooperative: This type of co-management is where government and users cooperate together as equal partners in decision making. For many, this is the true definition of co-management.

Type D: Advisory: Users advise government of decisions to be taken and government endorses these decisions.

Type E: Informative: Government has delegated authority to make decisions to user groups who are responsible for informing government of these decisions (Sen and Nielsen, 1996).

In Canada and many other countries, fisheries management has been driven by biological causes (growth rates, age at maturity, fecundity, etc) responding to the need to understand the human impacts of stock exploitation for economic gain. In more recent years, the understanding of stock exploitation and the fragility of fish stocks has grown considerably. In response to the need for more precise information on renewed exploitation, most government led fisheries science agencies have expanded their scientific research infrastructure. The result is the existence of centrally controlled, publicly funded fisheries agencies with major emphasis on scientific research function (Lane & Stephenson, 1998).

Other functions of a typical fisheries management organization include the fisheries operations tasks (industry liaison, and enforcement and monitoring), and a strategic policy and economic planning groups. These groups are staffed by civil servants who tend to move horizontally among government departments without necessarily acquiring ties to fisheries agencies. Science staff, however, with their highly specialised training in biological techniques and research tend not to migrate. The effect is to maintain stability, corporate memory, and growth in this branch but not necessarily in other branches of the fisheries organization (Lane & Stephenson, 1998). Consequently, there can be little integration of tasks and minimal awareness of responsibility across separate functions.

As a result of this type of system and structure, true co-management is very difficult to achieve. Scientific staff rely heavily on the data acquired by the department to run through their complicated models. Data from other sources, harvester groups, for example, may be perceived as less valid, as it is coming from "outside sources". Of the five types of co-management arrangements described earlier, it would seem that Type A would be most fitting in this situation. Also, harvesters posses a great deal of traditional and local ecological knowledge, which is not necessarily easily assimilated into a scientific database. It has only been since Canada's Oceans Act came into being that the Minister of DFO has been given the responsibility that he may "conduct studies to obtain traditional ecological knowledge for the purpose of understanding oceans and their living resources and ecosystems." (Department of Justice, 2013). In 1997, Canada became the first country in the world to adopt comprehensive legislation for oceans management. By passing its Oceans Act, Canada made a legal commitment to

conserve, protect and develop the oceans in a sustainable manner (DFO, 2013b). Since no particular methodology was prescribed, DFO is left with the challenge of accomplishing it.

5.1 NAFO Division 4WX Herring Fishery

There has, however, been a successful example of fisheries co-management of an important commercial species in Atlantic Canada. The NAFO Div. 4WX herring fishery is the largest herring fishery in the western North Atlantic, with annual landings in the order of 100 000 tonnes. This Canadian commercial fishery involves a variety of gear types including fixed gears (weirs, shutoffs, and gillnets), and a dominant mobile gear sector fleet of approximately 25 purse seine vessels that take over 80% of the annual catch. The commercial fishery has survived major changes in market emphasis and demand, and has been dominated at different times by sardine, fishmeal, fillet and roe (Lane & Stephenson, 1998).

This herring fishery has been at the forefront of innovative fisheries management (Stephenson, Lane, Aldous, & Nowak,1993) and twice in its history (both in response to crises) has advanced co-management relationships. Management has been carried out via annual management plans developed by DFO in collaboration with the Scotia - Fundy Herring Advisory Committee (SFHAC) with a general continuity on elements such as gear sector suballocation, and Individual Transferable Quotas (ITQ) transfers which have been imposed by a longer term plan established in 1983. A major change in

stock status prompted development of an in-season management system in 1994. The in-season management system represents a form of fisheries co-management.

The 1995 stock assessment indicated that the spawning stock had declined from about 600 000 tonnes in the late -1980's to perhaps as low as 200 000 tonnes. Consequently, DFO insisted on a cautious approach in the management of the Div. 4WX stock complex and set a reduced Total Allowable Catch (TAC) for 1994–95 at 80,000 tonnes (reduced from 150 000 ton TACs in previous years). Moreover, this TAC was set only on an interim basis to be reviewed throughout the course of the fishery.

The resulting Div. 4WX herring management plan stressed the importance of monitoring progress and signals in the 1995 summer fishery, particularly related to the spawning grounds, and required an in season re- evaluation of the fishery. To meet these requirements, the Scotia -Fundy herring purse seine monitoring working group (MWG), a subcommittee of the SFHAC, was established to evaluate information from the fishery on an ongoing basis. The committee was comprised of representatives from industry (the purse seine fleet, and the processing sector), and the federal government (fisheries operations /management, and fisheries scientists) (Stephenson & Lane, 1998).

The importance of timely and effective decisions to be made by the MWG during the 1995 season necessitated new information and structured approaches to dealing with the issues. This information included: (1) joint industry and DFO monitoring of stock size in fishing areas; (2) rapid compilation of data for dissemination to the MWG; and (3) analysis and use of the data in a form appropriate for consensus decision making. The MWG was provided with the mandate and empowered to make decisions on real fishing

limits for the remainder of the summer purse seine fishery. The committee, jointly chaired by a DFO manager and an industry representative, met routinely in person or by conference call to review new information and to decide on a course of action. Considerable progress was made on obtaining appropriate information on which to base decisions (Stephenson & Lane, 1998).

The Scotia -Fundy herring fishery demonstrates that a more effective fisheries management system can be developed by increasing the representation and decision making responsibility of fishing industry participants, and by shifting the scale of management from the aggregate to the in- season level of operations.

Earlier discussions and the case study above have dealt with the issue of integrated fisheries management of commercially important species that are data rich and highly valuable. However, in the Newfoundland and Labrador region, fishers have turned their attention to harvesting new and less economically valuable species, in an attempt to maximise the total value of their fishing season. Again, less economic value is defined here as either having a low price per weight ($/lb or $/kg) or low biomass with limited distribution. The harvest of these lower trophic level, less economically valuable species, presents an exciting opportunity for integrated fisheries management, which could bring academic research institutions into the process, along with fishers and government.

6.0 Integrated Management of Less Economically Important Species

The collapse of the groundfishery on the Canada's Atlantic coast resulted in major ecosystem changes and economic challenges. This collapse was compensated

for by the expansion of fisheries to lower trophic-level marine invertebrate and plant species, thereby following a global trend of declining average trophic level of fisheries. In Atlantic Canada, the monetary value of shrimp and crab landings alone now exceeds that of the former groundfishery ; however, lessons from other parts of the world indicate that the rapid expansion and profit from low trophic-level fisheries can be short term (Anderson, Lotze & Shackell, 2008).

In addition to their socio-economic importance, low trophic-level species play important ecological roles in the marine ecosystem. Most low-trophic-level invertebrate and plant species act as prey to higher trophic level species, some provide vital three-dimensional habitat, and others provide filtering function and nutrient storage, regulating water quality on which other species depend. Sea urchins in particular are known to be key engineers of the coastal algal community. From an ecosystem perspective, a change in trophic balance or a change in the strength of species interactions increases the potential for instability (Anderson et al., 2008).

Despite their ecological and increasing economic importance, most efforts at collecting baseline fisheries data in Canada have been directed at higher trophic-level species only. Concern has been raised about rapidly and simultaneously expanding low-trophic-level harvests while lacking sufficient baseline information to ensure sustainable fisheries development and marine ecosystem conservation (Anderson et al., 2008).

Anderson et al. (2008) evaluated whether low-trophic level fisheries on the Scotian Shelf had similar levels of knowledge reported for population, fishery, and

ecosystem parameters compared to developing and established fisheries. Their observations were based on the most recently published government stock assessments and research documents for each species. They discovered that emerging fisheries had significantly lower levels of population knowledge reported than developing and established fisheries, but higher levels of ecosystem knowledge than established fisheries (Anderson et al., 2008). The lack of important quantitative population parameters, such as biomass, growth rates, and geographic range, may hinder any thorough population assessment and impair a precautionary approach to management. The slightly higher ecosystem knowledge, on the other hand, may indicate that we have started to incorporate information on the ecological role of target species and the ecosystem effects of the fishery into management. Overall, however, emerging fisheries appear to have been developed more rapidly in terms of catches and value, than knowledge that has been acquired. Management based on the limited existing and only slowly increasing knowledge may be inadequate to ensure the long-term sustainability of emerging fisheries, which are of high ecological and increasing socio-economic importance in Atlantic Canada and elsewhere.

The expansion of fisheries to lower trophic levels may have several underlying drivers:

1. The collapse of the groundfishery created pressure to search for other socio-economic opportunities to earn an income and find employment.
2. Global markets for a number of invertebrate species were developed.
3. Only those species that occur in sufficient abundance can be regarded as viable fisheries options. The depletion of higher trophic-level predators such

as Atlantic cod has likely released many prey species from strong predation pressure.

6.1 DFO's New Emerging Species Policy

Unfished or underutilized marine species of potential economic importance exist off Canada's, and indeed, other countries, coasts. Shifts in world markets, declines in harvests of traditional species, maturing of existing markets and changing harvesting and processing technologies increase the likelihood that some of these resources will eventually be harvested. Indeed, several of these "new emerging" fishery species have been harvested elsewhere globally, and a sudden interest from outside nations where these resources are dwindling is instructive: good management and science is required at the forefront of new emerging fisheries development. The number of requests received annually for scientific/ exploratory licences for new fisheries demonstrate that there is an increasing interest in accessing these fisheries.

In light of this, in Canada, the Emerging Fisheries Policy was developed in 1996 to clearly lay out the requirements that must be met and the procedures that must be followed before a new fishery can be initiated. A cornerstone of the new policy is provision for the establishment of a scientific base with which stock responses to new fishing pressures can be assessed. This new policy replaced the Department of Fisheries and Oceans' (DFO) "Policy on Underutilized Species", which was no longer adequate in the current environment. Not only does the Emerging Fisheries Policy provide applicants with a transparent process to follow, it also gives DFO managers a procedure that can be applied fairly and consistently. This policy is also precautionary in its approach to the development of new fisheries. The objective is to diversify

fisheries and increase economic returns while ensuring conservation of the stocks and realizing the sustainable use of fisheries resources.

Management of new fisheries requires an integrated approach that would blend science and business principles and effective involvement of government, industry and other parties to ensure fisheries are ecologically and economically sustainable. It requires decisions on roles and responsibilities with regard to management, enforcement and scientific components within each exploratory harvest plan.

DFO continues to foster and develop emerging fisheries in co-operation with Provinces and Territories; "Provinces and Territories have an economic development mandate and, as such, have interest in the development of new fisheries that offer alternatives for the preservation and development of coastal regions and communities. In this role, Provinces and Territories may provide assistance, financial and otherwise, to corporate and individual proponents throughout the development process. In addition, the licensing and inspection (other than for export) of fish processing facilities, including those involved with emerging fisheries initiatives, are Provincial/Territorial responsibilities." (DFO, 2009).

In achieving this, the new fisheries policy is guided by the following:

- New fisheries must provide for a reasonable scientific basis for their management. The process by which new fisheries will be managed must include the requirement for stock assessment information in the early stages. Proponents will bear responsibility to maximize collection of scientific information from catches and for co-operative work with DFO scientists who will be responsible for analyzing the data/information obtained.
- New fisheries should contribute positively to the economical viability of a fishery enterprise on an ongoing basis.

- Under the proposed policy all requests from applicants must include proposals that outline research, management and conservation approaches as well as cost of these approaches (DFO, 2009).

Conservation cannot be compromised - a precautionary approach must guide decision making. Information on the abundance, distribution, and productivity of the target species is identified as the key scientific requirement for development of precautionary management strategies.

The potential impact or interaction of any new fishery or gear on associated or dependent species, fishing or gear type and on habitat will be assessed.

Based on biological and ecosystem information, including input from Aboriginal groups, industry, provinces/territories and the public, DFO will establish conservation standards, set conditions for harvest, and monitor their application (DFO, 2009).

Under these guidelines an exploratory fishing survey and biological resource assessment of Atlantic Hagfish (*Myxine glutinosa)* was conducted on the southwest slope of the Newfoundland Grand Bank (Grant, 2006).

7.0 Case Study: An Exploratory Fishing Survey and Biological Resource Assessment of Atlantic Hagfish (*Myxine glutinosa*) Occurring on the Southwest Slope of the Newfoundland Grand Bank (Grant, 2006)

There were many significant points that arose from this survey; probably the most important one is that this led to a 5 year (2004-2008) partnership for a resource assessment of Atlantic hagfish off Newfoundland. This was a commitment by all parties

involved; DFO, the vessel owner/operator, the funding agency and the Marine Institute of Memorial University, to collect information that would lead to the development of a long term sustainable Atlantic hagfish fishery. The funding agency provided the finances to allow this survey to occur, the owner/operator provided the platform from which the research could be conducted, the representatives of the Marine Institute collected and analysed the data and then provided it to DFO and industry, who then set the harvesting limits. A long term survey provides the opportunity to collect a larger amount of meaningful data than a single survey can. The data provided important information concerning several fisheries management issues including; biomass indices, species distribution, gear selectivity, sex ratios, and life history strategies including reproductive potential, fecundity and spawning cycle.

The primary objective of this study was to collect Atlantic hagfish from the southwest slope of the Newfoundland Grand Bank to obtain biological information necessary for making sound management decisions, with particular emphasis on the reproductive potential and elucidating the size at maturity. Secondary objectives included investigations into gear selectivity based on the diameter of escape holes in baited traps and whether catches warrant further investigations into the commercial potential of this resource (Grant, 2006).

The hagfish was not harvested to any significant extent in the past, as it was not considered to be economically significant. However, the provinces of Nova Scotia and New Brunswick had been considering the economic potential of the hagfish, in light of the declining stocks of Atlantic Cod, and the associated loss of income to harvesters.

Studies had also been carried out earlier on the harvesting potential of hagfish in the Newfoundland and Labrador region.

The most unique feature of this study was the list of all those who were involved in it. It was essentially a joint partnership agreement between DFO, a commercial fishing vessel owner/operator, the funding agencies responsible and the Marine Institute of Memorial University of Newfoundland. The funders were the Canadian Centre for Fisheries Innovation (CCFI) and the Newfoundland and Labrador Department of Fisheries and Aquaculture (DFA).

There was very little scientific data available that could be used to ensure a sustainable fishery for the hagfish. For example, juveniles are highly vulnerable to capture in baited traps and use of traps with very small escape holes can lead to over harvesting of juveniles (Grant, 2006). Since very little was known about the distribution and abundance of hagfish in the Newfoundland and Labrador region, it allowed for a significant contribution on the part of the commercial fish harvester.

During late autumn 2002, two exploratory fishing trips were conducted on the southwest slope of the Grand Bank, near the confluence of the Haddock Channel, NAFO Division 3O. Choice of survey area was based on traditional ecological knowledge (TEK) of gillnet fishermen, and a commercial fishing vessel was utilized as the fishing and sampling platform (Grant, 2006). In this particular instance DFO recognized that they did not have the scientific data necessary to determine distribution and abundance of hagfish in the Newfoundland and Labrador region, nor could they

provide a vessel to assist in the collection of this data. As a result they entrusted that responsibility to the harvesters.

Important data was collected during this study, resulting in important observations concerning the sustainable harvest of the Atlantic hagfish. The study established that a very high percentage of females caught had reached sexual maturity at the minimum size accepted by foreign markets in 2002. This is significant because it shows that the females have produced eggs and have had the opportunity to spawn at least once before being captured.

The study also demonstrated that harvesters using baited traps with small escape holes are likely to capture large quantities of juvenile and undersized hagfish. There is little data to indicate the survival rates of these discarded individuals, but it is well known that hagfish exhibit a low tolerance to changes in temperature and salinity. The study revealed that harvesters could reduce the numbers of juvenile and undersized individuals captured by selecting appropriate sized escape holes for their traps.

It can't be said that the success of this study is based wholly on the contribution of the harvesters and the input of information based on their traditional knowledge, but it can be said that their cooperation and input greatly increased the potential of success.

8.0 Conclusion

Throughout this paper, attention has been given to the evolution of fisheries management practices in Canada in general and Atlantic Canada in particular. There has been much discussion about the "top down" approach of fisheries management,

where the Federal Government determines management policies, based upon the collection of data by research surveys and commercial catch data. This style of management has been relatively successful in many instances, as the establishment and operation of ICNAF and NAFO have demonstrated.

There have been times when this approach hasn't been as successful, particularly when addressing issues of fisheries management and Canadian harvesters. During these times, the harvesters have not had the opportunity to contribute their opinions and suggestions to possibly improve the situation, since their data and knowledge has been anecdotal and acquired through experience. Traditional ecological knowledge was difficult to incorporate into the scientific database that had been amassed by the Department of Fisheries and Oceans, and other contributing departments and agencies.

Only the large scale, then highly lucrative, Atlantic cod fishery was referenced in examining the issues raised herein. Since the collapse of the Northern cod fishery and the resulting moratorium, many harvesters have begun to focus their attention on emerging and less economically significant fisheries. Unfortunately, DFO has not been able to significantly contribute in assisting the harvesters in these exploratory and developmental ventures. In recent years, DFO has been suffering from financial constraints and as a result, have not had the available resources necessary to collect and analyse new data associated with these new emerging species. Data is necessary to determine sound management plans for these new proposed targeted species, and alternative means of collecting information had to be found. In some instances, co-

management and sentinel fisheries strategies were developed, where harvesters assisted DFO in the collection of data, but did not have direct input into management strategies.

With the development of the Emerging Fisheries Policy in 1996, the harvesting industry finally had the opportunity to make a significant contribution to fisheries management. The policy provided an opportunity for the traditional knowledge of harvesters to be integrated into existing and new scientific databases.

The example of the exploratory fishing survey (Grant, 2006) and assessment (DFO, 2009) of Atlantic hagfish, illustrates the value of multiple member partnerships to collect information required to make sound management decisions. In this particular instance, funding agencies, Federal and Provincial governments, an academic institute and the harvesting industry all contributed to the collection and analysis of important fisheries information. This information could be analysed to determine whether the resource can sustain a commercially viable fishery, and to build databases for stock assessment purposes (Grant, 2006).

If this type of model continues to be followed, it could establish an increasing level of trust and respect between all potential partners, leading to an increasing number of cooperative research studies. This is particularly relevant when determining the viability for new and emerging fisheries where the ultimate goal is achieving a sustainable harvest of fishery resources.

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